REVIEW ARTICLE

# Relevance of H & S Faculties for the Engineering and Technology Subjects

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## ABSTRACT

This paper tries to give a graphic picture of how the I year B.E./B .Tech. syllabuses in the Institutes of Engineering and Technology is the foundation for the rest of the course content of different technical subjects they study during II, III and IV years of their professional courses. Those students who realize it at the beginning of their course orient themselves for good performance. Normally, a built-up structure and its vastness above the ground signify the strength of the foundation; similarly, in I year course of Engineering and Technology the handling of the syllabus by the members of the staff of H & S faculties is neither conspicuous nor valued enough. Moreover, in all the Engineering and Technology Colleges, I year course is named as a general course, more or less common to all branches of Engineering and Technology. In this context, it is required to show that H & S department serves in providing the foundation for the Engineering and Technical structures built subsequently.

**Keywords**: Engineering and Technology, Good Performance, Professional Courses, Intensive Engineering Research, Scientific Proposals.

## 1. INTRODUCTION

The H & S department plays a vital role in making the student settle well in his/her studies and understand the subjects with a firm grip so as to use them in comprehending the content of the syllabuses of II, III and IV years of study. A simple example is here: we are able to solve any launching problem with our knowhow and without any foreign help. Chandrayan and Mangalyan are the evidence. How are we self-sufficient in space launching operation?

Intensive Engineering research and development always follow the fundamental theoretical and scientific proposals made by the scientists of Physical Sciences. Certain of such transformed engineering principles are observed as mysteries of sciences. The development of many engineering marvels is due to the continuous interaction and feedback between the engineers and scientists who are engaged in the fields of research and development. The presence of the GOD particle (a BOSON), proposed more than seven decades ago, has been detected with the use of a huge equipment working at very high magnetic and electric fields; it deserves to be mentioned as an engineering marvel. Similarly, recent Nobel Prize for Physics, awarded for the discovery of gravitational waves, was associated with an instrument called LIGO (Laser Interferometer Gravitational wave Observatory). It too is an engineering marvel because this instrument has collected a chirp like signal from a distance of more than 3 billion light years from us. How did they filter the rest of the Cosmic Noise that accompanied the signal? It is a challenge to the electronics engineers! Such achievements in Civil

Engineering could also be mentioned. People are now after noiseless electric motors wherein the batteries are lightweight and rechargeable in a few minutes at any petrol station separately. This is possible because of the super capacitors working as storage batteries. In a decade's time Nano machines will be helping all the doctors to perform operations with the help of computer control without conducting the operation as in the normal manual way. It is proved that only a coherent and integrated theory, developed on the basis of solid Physical laws, finally results in the development of an engineering or technical method. Applications of any engineering subject and of any applied science for industrial use make a technological convergence which changes human lives radically and make human life more comfortable. It is here that Science and Technology go hand in hand. Theoretical scientists pose a problem which challenges the contemporary technology and demands the engineers to put in efforts to solve them. Here the H and S Department and the faculties/subjects therein keep young minds understand the basics to make a sincere approach to learn the rest of the subjects of their special branches. In recent times the gadgets working on the concept of Virtual Reality (VR) made a 3D view so simple that 3D printing of any engineering substitute is possible.

In a decade or two, computers may be loaded with human consciousness and people may be led into a virtual paradise; and, the speed with which a computer can make a calculation (based on a 2D circuit function) may be speeded up using a 3D electronic circuit configuration. Physical intuition and past experience with the basics of the subject may help in solving the problems encountered by the modern engineering subjects. Added to this, using the modern materials (composite materials, and nano materials having unusual properties both Physical and chemical) make the design and development a challenging issue.

Unless mathematical or theoretical methods (using computer software) are resorted to, the empirical methods clearly fail. In case of certain applications where in high temperatures, large applied forces, high pressures, high velocities and extremely different atmospheric conditions are the pre-inputs in research and development to reach a thorough understanding of the subjects.

The required subjects are normally (a) Engineering Physics and Chemistry; (b) Mathematics (Calculus); and, (c) Mechanics and Circuit Theory. With these subjects, the engineering study shall be very dynamic and goal oriented.

The H and S Department plays a vital role in making the student settle well in his studies and understand the subjects with a firm knowledge that these subjects are going to be used while the subjects of II, III and IV year of study are taught.

## 2. CORE SCIENCES AND TECHNICAL SUBJECTS

Let this point of view be verified. The subjects mentioned against each core science subject is taught to the engineering students in I year of professional course. In the Engineering Mathematics: Elementary functions, theory of Differential Equations having periodic solutions, Theory of Matrices, Laplace and Fourier Transformations. Line and Surface Integrals to mention as very much needed subjects. In the Engineering Physics**:** Diffraction, Quantum Mechanics, Band Theory of solids and semi-conductors, dielectric and magnetic properties are the basic subjects and Lasers, Fiber Optics and Nano Technology as applied subjects of importance. In the Engineering Chemistry**:** Electrochemistry with a good introduction on batteries up to fuel cells, Polymers with good introduction to materials in application (including superconducting alloys and Oxides). In Mathematics: Differential equations are of great importance in engineering, because many physical laws appear mathematically in this form. Newton's law of cooling and half-life of a radioactive material are basic topics to discuss.

The ordinary differential equations may be divided into two large classes: linear equations and nonlinear equations. Linear differential equations and their solutions are important in Engineering Mathematics. These equations are much simpler and help in solving the problems related to mechanical vibrations and networks. In a practical point of view, the second order linear differential equations are very useful. Once the students understand the procedure to handle these equations, they become familiar with higher order equations and the concepts in general.

As an example, $y' = \cos x$ or $y' = y,$ a simple equation, may have many solutions; and, its graphic representation gives more insight to the students.

**Mechanical Systems** such as Ordinary spring-loaded and also damped in oscillations with initial conditions, when defined, explain many points that match with human intuition. This forms the beginning of a student's realization that an equation corresponds to a physical system in operation.

Understanding this system is very easy as the required knowledge about Hooke's law and Newton's Second Law are taught at the Pre-

Engineering levels of education. This preliminary discussion gives a total picture of "Harmonic Oscillations": $m\dfrac{d^2 y}{dt^2} + c\dfrac{dy}{dt} + ky = 0.$

Defining the initial conditions, one can understand the motion of such a damped system. Specifically, when a linear coefficient dynamic system is disturbed by some forcing function, it results in a resultant motion as a combination of two components:

1. Forced Response
2. Natural motion (Exponential decay & Sinusoidal motion)

The time behaviour of all the signals--- representing Voltages, Forces, Displacements and many such time variables are expressible using $Ce^{st}$ (under constant coefficient linear systems): Root-locus technique helps in finding the factors and the system response can be determined. Here the exponential term with power x can be expanded as

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + ..., -\infty < x < \infty$$

A periodic function which repeats itself for every T sec (T being constant), the function of it can be represented as a sum of many pure sine waves whose frequencies are whole multiples of the frequency of the function itself and whose magnitudes are to be determined such that when all the sine-waves are added, the original function is produced.

The set of sine-waves is known as Fourier series and the set of coefficients, which tell the frequency content are very essential for a student to get the full picture. The function is represented as follows:

$$f(x) a_0 + \sum_{n=1}^{\infty} (a_n \cos \frac{n\pi x}{L})$$

Knowledge of different coordinate systems (like rectangular, cylindrical and Spherical) makes the application of mathematics to engineering subjects very appropriate. This helps in understanding, designing and fabricating certain devices and components.

Solid State Physics also finds application in advanced engineering subjects (part of the Engineering Physics) at many places. Some examples are as follows:

1. Fiber Optics- Optical communications (IV year)
2. Fourier Methods- Signals and Systems (II year)
3. Laplace Transforms- Control Systems (III year)
4. Nano technology- Nano Technology (III open elective)
5. Magnetic properties-Microwave theory and Components

Modelling a circuit numerically is a regular feature in engineering studies. For example, when microwave components are designed (with certain magnetic materials like ferrites) known as Circulators, Isolators and Tuneable filters, Integration techniques (mathematical methods) are adopted. In such cases, susceptibility of the medium in proportion with the power level, operating on the circuit, needs to be considered.

Knowledge of different coordinate systems (like rectangular, cylindrical and Spherical) itself makes the beginning of the application of mathematics to engineering subjects. A very important area where one can achieve expertise from theory and practical is microwave propagation and component design. In E. M. wave propagation, in all the three coordinate system representations, the second order partial differential equations are worked out using "separation of variables" method to get into three ordinary differential equations. This method is taught at I year level itself. By using the products of the solutions of O.D.E., one can get the solutions of partial differential equations.

During the delivery of the syllabus, electromagnetic theory, the boundary conditions for the electric and magnetic fields in the guided systems made of conducting and dielectric boundaries are usually discussed. The above fact helps in understanding the electric and magnetic field distributions in different waveguides. These distributions are known in normal notation as MODES. This helps the students imagine how a microwave component operates in a network, beginning from the source to the load. A student can design a microwave component on his own for any project or research work.

The idea, that a component working as a transmission line or as a resonator itself is the heart of the microwave technique. Similarly, the scalar and vector potential methods taught are the basics for Antennae design. Here the difference between

the coordinate representations helps one to understand clearly the scalar and vector functions.

### 3. ENGLISH

Last but most important subject of I year professional study is English. As this is the only subject under Humanities, the professional colleges generally pay less attention to it. Due to the dearth of English language experts and lack of research in this field, the syllabuses offered in English are miserably of low standard and are irrelevant to the needs of the students of the professional courses. While the universities abroad follow ESP (English for Specific Purposes) courses, these syllabuses are far from it as there is no reference to Technical English in them. As most of the teachers too do not possess expertise in English language pedagogy, the delivery is done just to complete the syllabus. If this situation has to be changed to make English relevant to the students, the colleges should offer in-house training to their English lecturers. If the colleges are willing to offer some extra help to their students, they should fill the gaps in the prescribed syllabus offered by the universities with the help of the experts in the ELT (English Language Teaching) field. The missing items, the relevant Interview skills and the soft skills for the CRT (Campus Recruitment Training) should be offered to the students in the Second year of the course. In the present globalised world, it is the saleability of the professional graduate that is counted more for recruitment than the marks sheet of the technical subjects. This saleability depends on the oral communication skills in English, soft skills and the attitude displayed in the screening/interview tests. So, imparting of the English language skills and other related skills should be taken rather seriously by the institutes of Engineering and Technology.

### 4. CONCLUSION

Unlike the other species of nature, human species achieved civilization and took the development to unimaginable heights. It has been possible due to the team work, in addition to the individual discoveries and inventions. A novel thought made by a core scientist pursued by a team of committed engineers and technocrats results in enormous development in engineering and technology. As the foundation of a structure decides its strength and longevity, the strong foundation in

the core sciences for the professional course students is decisive in their future progress in their respective fields. And, this could be done by making the students aware of the importance of their subjects of study in the first year course. Even this has to be done by the members of different faculties of H and S Department as a team work and not as a piecemeal teaching. Then the understanding of the advanced technical subjects is facilitated for the students. And, it is important that the members of I year teaching faculty make the significance of these foundation studies explicit to the students so that they succeed in making the right assessment of their importance. It ensures their attention towards the study of the subjects of I year syllabus with the right kind of awareness.

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